Between-Year Movements and Nest Burrow Use by Burrowing Owls in Southwestern Idaho

1996 Annual Report

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PROJECT SUMMARY

Our study was designed to (1) monitor between-year movements of burrowing owls, (2) examine the important habitat features of nesting burrowing owls, and (3) assess the effects of the 1995 Point fire on the distribution and ecology of nesting burrowing owls. In 1996, we conducted studies in two areas, referred to as the Kuna Butte and Grand View study areas. We have now monitored nesting burrowing owls in the Kuna Butte study area for three years (since 1994), while 1996 was the first year of our study in the Grand View area. We located a total of 32 nests in these two areas, 30 of which successfully fledged young during 1996. We individually marked 144 owls (N = 20 adults, 124 young), and banded an average of 3.9 ± 2.3 young per nest.

Seven owls with previous histories in the Kuna Butte study area returned in 1996. These owls included four males and three females, all of which paired and attempted to breed during 1996. Of 52 nestling burrowing owls banded in the Kuna Butte study area in 1995, two (one male and one female) were detected in the area in 1996. This yields a first-year return rate of 0.038 (i.e., birds returning/birds banded). Return rates were higher for adults than for young, however. Of five males banded as breeders during 1995, two returned in 1996 (return rate = 0.4 returns per bird banded). Of 14 adult females originally banded in 1995, two returned to breed in 1996 (rate = 0.143 returns per adult female banded). Higher return rates for males may reflect higher mortality in, or greater dispersal by, females. The average distance moved by returning adult males (N = 2) was 0 m. In each case, however, these males acquired a different mate in 1996 than they had in 1995. On the other hand, each of the adult females (N = 2) that bred in 1995 and returned in 1996 moved to a new nest burrow. These females bred 106 m and 503 m from their 1995 burrows, respectively. The young owls that returned bred 1.8 and 4.8 km from their natal burrows.

Nest sites in the Kuna Butte (N = 18) and Grand View (N = 14) study areas differed significantly with respect to features of the burrow itself and the vegetation surrounding the nest site. In the Kuna Butte area, burrows were significantly larger, there were significantly more burrows within 10 m of the nest burrow, perches were closer, and there was more tumble mustard and cheatgrass than in the Grand View area. Within each study area, there were very few differences between used and unused burrows. However, we did find that unused burrows had significantly steeper tunnel entrances, which the owls may have avoided, and used burrows were significantly more likely to contain livestock manure, particularly in the Kuna Butte area. This manure was likely collected by the owls to reduce predation, parasitism, or provide some other unknown function.

Finally, this study examined the use by nesting burrowing owls of recently burned areas in the Kuna Butte study area. All of the nest sites that were burned in 1995 by the Point (large fire near Initial Point) and other fires were reoccupied in 1996. Moreover, several additional burrows within the burned areas but with unknown histories were occupied by nesting owls in 1996. Because the fires occurred when young owls were capable of flight (i.e., late in the summer during the post-fledging period), no direct mortality of owls was observed. These initial observations suggest that the fires did not adversely affect the burrowing owls in this area.

INTRODUCTION

Burrowing owl (*Speotyto cunicularia*) populations are declining throughout much of their range (Haug et al. 1993). These declines have been attributed to control measures aimed at burrowing mammals, loss of habitat to cultivation and other land use activities, predation, and persecution by humans (Collins 1979, Rich 1986). Because of population declines, resource agencies in both the United States and Canada have listed burrowing owls among the species in need of management or special attention. Burrowing owls are listed as *endangered* in Manitoba, Iowa, and Minnesota, as *threatened* in Saskatchewan, Alberta, and British Columbia, and as a *species of special concern* in a number of western states (CA, MT, ND, OR, WA, WY) and in Florida. Idaho Fish and Game and the U.S.D.I. Bureau of Land Management considers burrowing owls as a *sensitive* species in Idaho.

Although there have been no systematic surveys performed, it appears that burrowing owl populations in southwestern Idaho, and specifically within the Snake River Birds of Prey National Conservation Area, are not declining precipitously, and the birds are somewhat common in areas where habitat conditions are suitable. Therefore, it is important to collect as much information about these birds and their interactions with habitat as possible, because it may be useful for understanding why populations in other areas are declining.

Our objectives in this study were to (1) continue color-banding burrowing owls to provide information on return rates to the study area, site fidelity, and between-year movements (i.e., breeding and natal dispersal) by adults and young, and (2) measure habitat and burrow characteristics to determine which features, if any, are important for nest site selection. We also wanted to examine the effects of a recent burn event, the 1995 Point fire which occurred south of Kuna and near Initial Point, on habitat use and return rates of burrowing owls in the southern portion of one of our study areas. This report summarizes our activities and data collected during the spring and summer of 1996.

METHODS

Study Areas

We studied burrowing owls nesting singly and in loose colonies in two study areas in southwestern Idaho. The first area, in which we have monitored nesting burrowing owls since 1994, was located approximately 3.2 km south of Kuna, in Ada County (Fig. 1). This area is characterized by big sagebrush (*Artemisia tridentata*) shrubland, and disturbed grasslands dominated by cheatgrass (*Bromus tectorum*) and tumble mustard (*Sisymbrium altissimum*). Surrounding areas contain irrigated agricultural fields (primarily alfalfa, wheat, and sugar beets), scattered residential homes, and a large dairy farm. The topography of the area is flat to slightly rolling with a few isolated buttes and rock outcroppings. There was a relatively high density of burrows excavated by badgers (*Taxidea taxus*) and yellowbellied marmots (*Marmota flaviventris*), which burrowing owls used for nesting and shelter throughout the breeding season.

The second study area was located approximately 8 km north northeast of Grand View, Elmore County, Idaho and adjacent to State Highway 67 (Fig. 2). This area was a mosaic of irrigated agriculture and disturbed grasslands. This was the first year that we monitored owls in this area.

Locating and Capturing Burrowing Owls

We searched suitable habitat in each study area for burrowing owls both on foot and from automobiles. Although many surveys were performed during late afternoon and early evening, we surveyed throughout all hours of the day and night. Frequently, we played a tape-recorded burrowing owl call (Haug and Didiuk 1993) over a loudspeaker (Johnny Stewart® Game & Animal Caller) to which owls responded with vocalizations. This helped identify the location of nesting owls. After locating owls, we monitored their nesting activities on a regular basis.

To capture owls we used Havahart® traps and noose rods as described in Belthoff et al. 1995 and King (1996). Upon capture, we recorded each owl's mass (to nearest 0.5 g), wing length, tarsus length, tail length, and length of exposed culmen (all to nearest 0.5 mm). We classified adult owls as females if they had well-developed brood patches. We were unable to discern gender of young owls based on appearance or morphological measurements. We fitted owls with a U.S. Fish and Wildlife Service aluminum leg band and three plastic, colored leg bands (National Band and Tag Co., Newport, KY) for future identification.

Owl Monitoring

Follow-up visits were made to each nest burrow to determine if nesting attempts were successful. Successful nests had at least one young owl survive to fledging age. We also recorded the number of young owls observed at the entrance to all nest burrows, from which we calculated number of young produced. The maximum number of young observed at the entrance to a burrow could be used as an index to the minimum number of young produced by the nesting pair.

Nesting Habitat

Our study not only was interested in describing the nesting habitat of burrowing owls, but we also wanted to determine which if any characteristics of the nest burrow or surrounding vegetation were important in the choice of a site by a pair of burrowing owls. To demonstrate that individuals choose nest sites nonrandomly from the available pool of burrows, used and unused sites must differ along at least one dimension of habitat. To investigate this possibility for burrowing owls in our study areas, we recorded the physical attributes of the nest burrow and surrounding vegetation at all used burrows and at the nearest, seemingly suitable, unused burrow. We used nearest neighbor burrows for the comparison because these burrows realistically could have been visited and rejected by the resident owls. All measurements were made during late summer (26 August - 21 September 1996), so vegetation measurements represent those conditions that owls experience during the post-fledging period and prior to migration.

At each site we measured characteristics of the nest burrow, which included the height and width of the entrance, height of the mound near the entrance of the burrow, angle of burrow entrance (deviation from horizontal; the larger the angle, the steeper the entrance tunnel) and the compass orientation of entrance. We also measured characteristics of the surrounding vegetation, including average vegetation height at 0.5 and 2 m from burrow entrances. Within a circle with 50 m radius and centered on the nest or nearest neighbor burrow, we also estimated the relative proportion of the following vegetation categories: (1) cheatgrass, (2) rabbitbrush, (3) irrigated agriculture, (4) tumble mustard, (5) rock, (6) annual wheatgrass (*Eremopyrum triticeum*), (7) sagebrush, (8) bare ground, (9) clasping pepperweed (*Lipidium perfoliatum*), and (10) all others. Finally, we measured distance to and type of nearest perch, height of perch, distance to irrigated agriculture, type of crop, distance to and type of nearest road, and distance to and type of nearest water source.

Data Analyses

We divided analyses into tests of burrow characteristics and tests of vegetation and other measurements. We compared mean values of nest sites in the Kuna Butte and Grand View study areas, and used and unused sites in each area, using univariate and multivariate analysis of variance. Data derived from circular distributions (e.g., burrow entrance orientation, angle corresponding to "steepness" of burrow tunnel at entrance) were analyzed using circular statistics (Zar 1984). Mean angles (a) and angular standard deviations (s) were calculated for each sample. The length of the mean vector (r) ranges from 0 - 1 and varies inversely with the amount of dispersion in the data. For example, when $r = 1.0$ all data are concentrated in the same direction, and $r = 0$ when there is so much dispersion that a mean angle cannot be described. We used Rayleigh's test to examine the null hypothesis that the population of interest is uniformly distributed around the circle (i.e., in all directions) and compared mean angles between groups using the Watson-Williams test (Zar 1984).

RESULTS

Trapping and Banding

Between 28 May - 31 July 1996, we captured 144 burrowing owls in the two study areas. These included 6 adult males, 14 adult females and 124 nestlings and fledglings. Appendix A contains band numbers, banding dates, color band combinations, age and sex information for owls captured during this study. A lower proportion of adults was captured than in previous years of our study, primarily because trapping was initiated approximately two weeks later in the season, and adults become more difficult to capture as the breeding season progresses.

Returns of Previously Banded Owls

Number of Birds Returning in 1996 — This was the first year for capturing and banding owls in the Grand View study area, so no data on return of adults or young will be available for this area until after the 1997 breeding season. In 1996, seven burrowing owls with prior histories in the Kuna Butte study area returned to breed there (Table 1). These birds included four males and three females, all of which paired and attempted to breed during 1996 (Table 1). The identity of five of the birds was confirmed by capturing them and verifying aluminum leg band numbers. The remaining two birds eluded capture and/or color-bands could not be observed to positively identify the birds. The first of these birds, an unmarked male, bred at the Sewage Pond #2 nest. This male was significantly more aggressive than any other male that we have encountered; for example, on each of our approaches to this nest, the bird approached, called consistently, and hovered above us. This behavior contrasts with most if not all other males in the study area in that these males frequently fly away from the observers upon approach. The male observed at the Sewage Pond #2 nest in 1995 exhibited the same behavior as this unknown male in 1996, and therefore we are fairly confident that the 1996 male was the same individual as in 1995. The other unknown bird, the 1996 adult male at Kuna Butte #7, was banded as a nestling in 1995 and equipped with a radio package. The radio was no longer functional in 1996, so positive identification was not possible. Nonetheless, this young male returned to the study area to breed in its first potential breeding season.

Rate of Return — A total of 52 nestling burrowing owls was banded in the Kuna Butte study area in 1995, of which two (one male and one female) were detected in the area in 1996. This yields a first-year return rate of 0.038 (i.e., birds returning per birds banded). Of course, this rate represents a minimum because (1) all young produced within the boundaries of the study area in 1995 were not banded, so some of the breeding adults banded in 1996 could have been produced in the study area during 1995 but remained unbanded, and (2) it is possible that more birds returned to the study area during the 1996 breeding season but went undetected. Return rates were higher for adults than for young, however. Of five males banded as breeders during 1995, two returned in 1996 (return rate = 0.4 returns per bird banded). Of 14 adult females originally banded in 1995, two returned to breed in 1996 (rate = 0.143 returns per adult female banded). At this point, we have little information to determine if the higher return rate for males reflects higher survival in males or greater breeding dispersal (i.e., out of our study area) by females, although we feel the latter may be more likely (see Summary and Conclusions).

Distance of Movements for Young and Adults — The two adult males that bred in the Kuna Butte study area and returned in 1996 used the same nest burrow in both years (Table 1). Thus, the average distance moved by returning adult male burrowing owls was 0 m. In each case, however, these males acquired a different mate in 1996 than they had in 1995. Neither of these females was observed within the study area during 1996, so it is not known if these females died or dispersed from the area. On the other hand, each of the adult females (N = 2) that bred in 1995 and returned in 1996 moved to a new nest burrow (Table 1). These new burrows were 106 m and 503 m from the 1995 burrows, respectively. We were unable to discern if these females retained the same mates between years because the males went uncaptured during each year.

In 1996, one owl banded as a nestling in 1994 bred at a burrow that was 1.8 m from its natal burrow (Table 1). Another young (1996 Dairy #7 female) bred 4.8 km from its natal burrow at Kuna Cave #2. Finally, the identity of the first-year radio-tagged owl was not known, so it was not possible to determine how far it was from its natal burrow when it bred at the Kuna Butte #7 nest in 1996.

Reuse of Nesting Burrows Between Years

Even though turnover of individuals in the Kuna Butte study area appears to be relatively high (based on the relatively low rates of return by both adults and young), it is interesting to note that individual burrows frequently are reoccupied in multiple years. For example, five burrows were used for nesting in all three years of our study, while nine others were used for at least two years (Table 2). Of particular interest is that there is a tendency for burrows to remain unoccupied in subsequent years if nests in these burrows failed in previous years. All six nests that failed to produce young during 1994 remained unused in the subsequent two years of our study (Table 2), although one of these nests (Kuna Butte #1a) was destroyed when some manure piles were moved by local farmers. In contrast, of the 10 burrows that successfully fledged young in 1994, seven (70%) were reused at least once (Table 2).

Reproductive Success of Pairs

We were able to determine the outcome at 18 nests in the Kuna Butte study area and 14 nests in the Grand View study area (Table 3). All but one of the nests (94.4%) in the Kuna Butte area successfully fledged young, while 13 nests (92.9%) were successful in the Grand View study area. In the Kuna Butte area, we observed an average ($\pm$ SD) of 4.6 ± 1.8 young per nest monitored and were able to capture and band 3.8 ± 1.9 young per nest. An average of 4.0 ± 2.9 young was banded at the 14 nests monitored in the Grand View area, while we observed 5.1 ± 2.4 young per nest in this area. It is important to note that number of young observed at each nest reflects minimum average reproductive success per nest by breeding owls in the two areas. Because some young most certainly eluded observation or capture and banding, and monitoring and trapping efforts were not uniform for each nest within each area, realized reproductive success was likely greater.

Nest Site Habitat

We measured burrow and habitat features at 32 burrowing owl nest sites (N = 18 near Kuna Butte and N = 14 near Grand View) and 31 nearest neighbor burrows in the two study areas. We were unable to locate a nearest neighbor burrow within a reasonable distance for the Substation South #3 nest in the Grand View study area, and this accounts for the lower sample of unused burrows. Summaries of habitat data sheets for the 32 nest burrows are provided in Appendix B.

Burrow Characteristics — Burrow characteristics (entrance height and width, mound height, number of burrows within 10 m) at nests differed significantly between the Kuna Butte and Grand View study areas (MANOVA, Wilk's lambda = 0.7203, $F = 2.62$, $P = 0.057$; Table 4). Nest burrows in the Kuna Butte study area had larger entrances (both height and width) and more burrows within a 10 m radius of the nest burrow; mound height did not differ significantly between study areas. Entrance orientation (Watson-Williams test, $F = 9.51$, $P < 0.01$) but not tunnel angle ($F = 1.10$, $P = 0.30$) differed significantly between sites as well (Table 4).

Because of differences in nest burrow characteristics between study areas, we performed separate analyses of used vs. unused burrows for each study area. The above burrow characteristics did not differ significantly between used and unused burrows in either study area (Kuna Butte: Wilk's Lambda = 0.9779, $F = 0.175$, $P = 0.949$; Grand View: Wilk's lambda = 0.888, $F = 0.694$, $P = 0.604$; Table 4). However, tunnel angle was significantly greater in unused burrows in each study area (Table 4, Fig. 3). Entrance orientation differed in used and unused burrows in the Kuna Butte but not Grand View study area (Table 4, Fig. 4).

Vegetation and other characteristics — Vegetation height and other nonburrow features (e.g., distance to nearest perch, perch height, distance to irrigated agriculture, roads, and water) also differed significantly between nest sites in the Kuna Butte and Grand View study areas (MANOVA, Wilk's lambda = 0.219, $F = 11.186$, $P < 0.001$; Table 5). Vegetation both within 0.5 m and 2.0 m from nest burrows was significantly taller in the Kuna Butte area, and perches were significantly farther away in the Grand View area. We noted no differences between study areas in height of perches, or distances to agriculture, roads, or water (Table 5). There were differences between study areas in the types of vegetation within the 50 m radius of nest burrows. For example, nest burrows in the Kuna Butte area were characterized by having greater proportions of both cheatgrass and tumble mustard, while nests in the Grand View study area had more annual wheatgrass and clasping pepperweed (Fig. 5).

Because the above vegetation and nonburrow features of nest sites differed between study areas, we performed separate analyses by study area to determine if used and nearest neighbor, unused burrows differed. However, in neither study area did used and unused sites differ significantly for the above vegetation and nonburrow features (Kuna Butte: Wilk's lambda = 0.984, $F = 0.053$, $P = 0.99$; Grand

View: Wilk's lambda = 0.776, F = 0.782, P = 0.61; Table 5). When we examined the relative proportions of the 10 habitat categories around used and unused burrows within each study area, no differences of note were discovered (Figs. 6 - 7). Perhaps this is not unexpected, given that unused burrows were nearest neighbors to nest burrows, and habitat measurements around the two groups overlapped to some extent. Finally, we observed that used burrows were more likely to contain livestock manure or other ungulate (e.g., pronghorn, *Antilocapra americana*) dung in both the Kuna Butte (8/18 used burrows with manure, 1/18 unused burrows with manure) and Grand View (8/14 used burrows with manure, 4/13 unused burrows with manure) study areas, although only the former was significantly different (test for difference of proportions: Kuna Butte, $z = 2.303$, $P = 0.021$; Grand View, $z = 0.987$, $P = 0.324$).

Use of Burned Areas by Nesting Burrowing Owls

Range fires (including the 1995 Point fire) burned the southernmost portions of the Kuna Butte study area in 1995 and 1996. Nest sites located within areas that burned in 1995 included Kuna Cave #2, John Hayes #1, and Sewage Pond #1 and #2 (the sewage pond sites were purposely burned to control weed growth). The fires did not cause direct mortality, nor did they appear to have adverse effects on adult or juvenile owls (already of fledging age) which were repeatedly observed at these sites for several weeks after the fires. In addition, each of these nest sites was reoccupied and successfully fledged young during the 1996 breeding season. Other sites that had been burned in 1995 and were occupied by owls in 1996 included Effluent Field North, Effluent Field South, and Swan Falls #4. Moreover, juveniles from several different families (e.g., Kuna Butte #3) dispersed from unburned areas into burned areas immediately following the fires in 1995. Additional nest sites that were burned in fires during the 1996 breeding season included Swan Falls #3 and #4; monitoring during 1997 will determine if these nest sites are reoccupied after being burned.

SUMMARY AND CONCLUSIONS

Return Rates and Between-Year Movements of Owls

Our multiple-year studies of burrowing owls are now yielding important information about the return rates and between-year movements of burrowing owls in the Kuna Butte study area. In 1996, we also initiated a banding and monitoring program in the Grand View study area, and field work during future years will yield similar information for owls in this population.

Return rates for adults and young — From all indications (e.g., Belthoff et al. 1995, King 1996, pers. observ.), burrowing owls in our study areas in southwestern Idaho are obligate migrants, whereby all members of the breeding population move elsewhere (presumably southward) to winter. This is in contrast to breeding populations of burrowing owls in New Mexico (Botelho 1996), for example, where the owls are partial migrants (i.e., only a portion of the population migrates). Thus, any individual observed in our study area in more than one year must have navigated from wintering areas to facilitate its return during the breeding season. Currently, however, we have no information, band returns or otherwise, about where members of our breeding population overwinter.

We found that the 1996 return rates for individually marked adult males and females in the Kuna Butte study area were 0.40 and 0.14 per bird banded during 1995. The lower return rate for females reflects either increased mortality in members of this sex class, increased dispersal, or a combination of both. Breeding dispersal occurs when adult owls move between breeding attempts or between years and may (1) allow a bird to find a better mate than they had in previous years, (2) to find a better territory or site, (3) be a result of social constraints (e.g., social dominance), or (4) may depend on genetic predispositions which are passed along kinship lines. In many bird species, breeding dispersal is female-biased (e.g., see Payne and Payne 1993) and males tend to be significantly more philopatric. Our data from 1996, although limited, may suggest that the difference in return rates is a result of greater female dispersal rather than increased mortality in this sex class. For example, both of the adult males that returned to breed in 1996 did so at the same burrow as in previous years; this yielded an average breeding dispersal distance of 0 m for males and reflects high philopatry in males. In contrast, both of the adult females that returned to breed in the Kuna Butte study area moved to different burrows in 1996. Thus, between breeding seasons, females appear to be more likely to move than males, and if more females than males moved out of our study area, this could account for the differences in return rates that we observed. Why female burrowing owls moved more than males between years remains to be determined.

The movement of young birds from their area of birth to their first breeding site is referred to as natal dispersal. In resident species, this movement is usually accomplished in late summer when young, independent birds leave their natal area and strike out on their own (Belthoff and Dufty 1997). However, in migratory species like the burrowing owl, natal dispersal is more complex. In late summer birds usually make a post-fledging dispersal movement that takes them away from the area of their natal burrow (Belthoff et al. 1995, King 1996). In 1994, 15 radio-tagged burrowing owls dispersed an average of 1.4 km from their natal burrows during the post-fledging period, ranging from around 200 m to over 3.6 km (Belthoff et al. 1995). It is in these post-fledging areas that young birds prepare for their initial migration southward. Then, during the following spring, it is not clear if another dispersal movement is accomplished following return to either the natal site or to the site occupied after the post-fledging dispersal movement. In either case, however, one can calculate the proportion of young returning to the study area, measure the distance between the natal site and the breeding site, and calculate the natal dispersal distance. Just 2 of 52 individuals banded as juveniles in 1995 returned to breed in the Kuna Butte study area in 1996 (return rate = 0.038). Just as for the adults discussed above, the fate of the birds that did not return is unknown because they could have died, dispersed beyond the boundaries of our study area, or failed to return to breeding grounds during the first potential breeding season. The single bird that bred in the study area in its first potential breeding season and for which we had adequate information moved 4.8 km from its natal site. This is considerably farther than either adult males or adult females moved between breeding seasons. Just as we observed for burrowing owls, lower return rates and greater dispersal distances for juveniles compared to adults are characteristic of the population dynamics of many avian species (e.g., see Payne and Payne 1993).

Burrow reuse — The reuse of burrows from year-to-year by breeding populations of burrowing owls is not uncommon (Haug et al. 1983), but the rate of reuse seems to vary among populations. For example, Martin (1973) observed that each of 15 pairs of burrowing owls he studied in New Mexico used burrows that had been occupied in previous years; Gleason (1978) reported 9 of 15 burrows occupied in the second year of study in eastern Idaho; and Plumpton and Lutz (1993) found that 4 of 20 (20%) nesting burrows were reused during the second year of their study in Colorado. Finally, in southcentral Idaho, Rich (1984) determined that of 242 nest sites located between 1976 - 1983, 115 (39.4%) also were occupied in at least one subsequent year, although this study did not confirm breeding in all sites included.

Our study in the Kuna Butte area has documented breeding and reuse of nest burrows by burrowing owls since 1994. Of 30 individual nest burrows discovered during 1994 - 1995 in this area, 15 (50%) were reused in a subsequent year. One important discovery of our study is that burrows are rarely reused if the nests in them fail to fledge young. For example, all of the 1994 nests that failed, and the one nest that failed in 1995, were not reoccupied in subsequent years. This is in contrast to burrows containing successful nests, which were reoccupied at a high rate.

These studies illustrate what may be an important opportunity for management of burrowing owl populations. Over just the few years of our study, we have observed nest burrows being destroyed through agriculture, fire rehabilitation, and various other activities. Given what appears to be a strong tradition of burrow reuse in this species and in our study area, preventing destruction of preferred burrows (e.g., those that successfully produce young), likely could be one simple way to avoid declines in population numbers. Such management practices would be most critical in areas where burrows are limited in availability.

Nest Site Characteristics

Burrowing owls in our study areas nested in sites with abundant burrows, close to roads and agricultural fields, and areas containing exotic plant species such as cheatgrass, tumble mustard, and annual wheatgrass. Many of the parameters we noted are similar to previously published accounts from other portions of the range of burrowing owls (e.g., Colorado, Plumpton and Lutz 1993; Saskatchewan, Haug et al. 1993). We found that nest sites in the Kuna Butte and Grand View study areas differed significantly from each other. Specifically, nests in the Kuna Butte area were in burrows with larger openings, near significantly more burrows, closer to perches, surrounded by significantly taller vegetation, and contained a larger proportion of cheatgrass and tumble mustard than nests in the Grand View area. Certainly, local differences in disturbance regimes as well as climate and precipitation account for some of these differences. For example, portions of the Kuna Butte study area have burned in recent years, and these burned areas have been replaced by dense mats of cheatgrass and tumble mustard. Similarly, drier conditions prevailed in the Grand View area during 1996, and this was reflected in lower average vegetation height across this study area. It is not clear why burrows were larger in the Kuna Butte study area, but one hypothesis is that the burrows may have persisted for a longer time than those in the Grand View area, and frequent reuse by fossorial mammals as well as burrowing owls may have enlarged them.

Despite differences in burrow characteristics and vegetation surrounding nest sites between study sites, it was apparent that used burrows were generally similar to unused burrows in both areas because few of the variables we examined differed between the two types of burrows. Many of the similarities are certainly the result of our sampling protocol. Because we sampled nearest neighbor rather than randomly selected burrows for comparison with used sites, we probably reduced the chances of finding significant differences for many of the parameters, primarily because nearest neighbors were often close to used burrows and at times sampling areas overlapped. Nonetheless, two variables differed consistently between used and unused burrows in both study areas, tunnel entrance angle and presence/absence of livestock manure, and both of these may have some management or monitoring implications.

Tunnel entrance angle was significantly steeper in unused burrows both in Kuna and Grand View. Burrowing owls may prefer burrows with more gradually sloping tunnels because such entrances may facilitate the movements of young owls who have poor locomotor skills. Whatever the cause of this apparent avoidance by burrowing owls of burrows with more steeply sloping entrances, this information may be particularly important for managers contemplating the use of artificial nesting structures to augment declining populations. These structures have been used in a variety of locations and under a variety of circumstances (e.g., Martell 1990, Olenick 1990, Trulio 1995, Botelho 1996), but there have been few systematic studies to determine how to correctly construct and configure the artificial structures so that they meet the requirements and or preferences of nesting burrowing owls. Data from the present study would suggest that managers be attentive to the angle of the entrance, perhaps limiting it to gradual slopes of not more than approximately 35°.

Our data also indicate that a burrow containing a nest has greater evidence of livestock manure than other burrows that may frequently be used (e.g., satellite burrows). The presence of fresh manure as well as a debris ring at the entrance to a burrow is often an indicator of an active burrowing owl nest, and this could be helpful in monitoring programs that do not have the time or resources to confirm breeding or to capture and band owls to monitor individual reproductive success. However, there are two caveats that must be made about using presence of livestock manure to assess active nesting in a burrow. First, not all nest burrows have manure; only 44% and 57% of used burrows contained manure in the Kuna Butte and Grand View study areas, respectively. Second, a small proportion of unused burrows contained manure in each of the study areas. These burrows could represent active satellite burrows (see King 1996), nests which have been abandoned earlier in the season, or burrows in which owls nested in previous years. A good approach for managers might be to determine the percentage of burrows in each group (used and unused) that contain manure, and adjust their estimates of occupancy based on monitoring efforts accordingly.

Effects of 1995 fires on Nesting Burrowing Owls

Both young and adult burrowing owls used burned areas in the days and weeks following the 1995 fires. Moreover, each of the nest burrows within the Kuna Butte study area that was affected by the 1995 Point fire was reoccupied in 1996. Therefore, it appears that disturbances such as these, i.e., those that occur during the late summer when young owls are capable of flight, do not have major adverse effects on the owls. Fires that occur earlier in the season may cause direct mortality of young owls that are incapable of fleeing, although conditions are less suitable for range fires at this time of year, and no fires such as these have occurred during our three years of work in the Kuna Butte area. Burrowing owls may actually benefit from some fires which convert areas with dense sagebrush into grasslands, their preferred habitat, particularly if such grasslands are established in areas near irrigated agriculture (see Leptich 1994).

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